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ABSTRACT

A study of 128 third graders was made to determine whether audiovisual media does facilitate cognitive development by comparing the effects of learning a mental skill from a filmed demonstration of that skill with learning from more active kinds of experience. The mental skill was the ability to mentally transform mental images by rotating them around fixed axes. The children were tested on a series of spatial tasks and verbal tasks, then following pretesting the subjects were assigned to one of five groups. Three groups viewed films; one viewed the complete rotation film, one viewed the partial rotation film, and one the film with all rotations edited out. The fourth group received individualized training in rotating blocks to determine congruence. The fifth group served as the control group and received no additional training. Following training, the five groups were given two batteries of posttests. The results showed that audiovisual media can facilitate the development of cognitive skills in children. The children's ability to rotate images internally was facilitated by viewing external representations of objects rotating in space and such facilitations were comparable to the facilitationsfrom direct active experience. (Author/DS)

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CAN AUDIO-VISUAL MEDIA TEACH CHILDREN MENTAL SKILLS?

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In light of the many recent developments in children's educational television, an important question still remains to be answered: can children acquire mental skills from audio-visual media? Critics of educational television and television learning frequently say that because the information children acquire from this medium is passively obtained, children are learning only rotely and not conceptually. The critics argue that since television does not provide the child with suitable occasions for active participation when learning, television can only give the child facts or knowledge; television, they say, has very little if any real benefit for children's conceptual development. The present paper addresses itself to the issue of whether audio-visual media can facilitate cognitive development by comparing the effects of learning a mental skill from a filmed demonstration of that skill with learning from more active kinds of experience.

While a number of developmental psychologists have expressed an interest in the possibility of children acquiring mental skills from media, there is no concensus as to how media might work. One view is the one already mentioned: namely, media cannot possibly benefit mental development since they do not provide the appropriate occasions for active mental participation. Piaget, who would represent this point of view, explicitly says that media "are totally inadequate" because they only supply learners with "representations... of objects of the events or the results of possible operations... without leading to any effective realization of these operations themselves". He also says "a pedagogy based on the image, even when enriched by the film remains inadequate for the training of operational constructivism since the intelligence cannot be reduced to the images of a film (but requires) the primacy of spontaneous activity and of personal or autonomous investigation".[1] (1970, 72-75).

A second view is that offered by Salomon[2]: he has claimed that media can teach mental skills when the skill in question and the medium's "code" are similar. If this is the case, then the learner should imitate and internalize this "code" much like he imitates and internalizes other kinds of behaviour. By "code" he means the devices or techniques by which information is conveyed over the given medium. Preliminary research by Salomon with some audio-visual codes like the zoom device has indicated that children exposed to films continuously using such devices will show marked improvements in areas of cognition related to those devices, like the ability to select details from a complex array.

A third viewpoint is that expressed by Olson and Bruner[3] and is intended primarily for the acquisition of physical skills: they claim that one can acquire information about a performance from many forms of experience including experience that does not involve direct physical contact with real objects. This information is said to be instructive if it is used by the learner to become more competent. They say that demonstrations shown live or via a medium are often valuable for training skills if they draw attention to the key aspects of the performance, showing the learner what to do - as well as what not to do - at these critical points. In fact they suggest that demonstrations shown over audio-visual media can even surpass the effects of live experience and direct contact because techniques like slow motion, stopped action, close-ups, etc. can serve to highlight the activities to be learned. Support for this claim can be seen in the recent trend to use video-tape equipment in the training of many sports. So, if it appears that audio-visual media can be useful in the development of a number of physical skills, can this also be true for the development of some mental skills?

The present study was designed to determine whether a mental skill in the realm of spatial thinking could be improved by viewing a filmed representation of that skill. The mental skill was the ability to mentally transform mental images by rotating them about fixed axes. Research by Shepard and Metzler[4] has shown this to be the strategy or process adults use to solve a task requiring them to determine whether pairs of objects not readily describable in verbal terms are the same when the objects are shown in different orientations in space. According to some investigators[5,6,7] of children's spatial development, the ability to imagine rotations is not acquired until relatively late in childhood, at about age 9. Furthermore Piaget also claims this ability is one which is derived primarily from active experience in rotating real objects in space and is later internalized as a mental act; this ability he argues is not acquired from media. Since objects rotating in space could readily be animated on film and since a comparable form of active experience in rotating objects to that shown on film could be given, this seemed an interesting task to film for studying whether audio-visual media can facilitate the development of a cognitive skill.

The study I am about to describe deals with five basic questions:

1. Can children's performance on a spatial matching task, like Shepard and Metzler's be facilitated by filmed demonstrations of objects rotating into congruence?
2. How does a filmed demonstration of rotating objects compare with learning actively from experience in physically rotating real objects?
3. To what degree does a demonstration of a complete rotation compare with a demonstration of a partial rotation or a demonstration showing no rotation at all?

4. Will the effects of the different kinds of experiences in rotating objects transfer to other spatial abilities?

5. For whom are the different kinds of training most beneficial?

128 Grade 3 children were initially tested on a series of spatial tasks and verbal tasks. One of the spatial pretests was a simplified version of the Shepard-Metzler rotations task shown over slides. The first slide (see Figure 1) shows a sample item of the test. In this version of the Shepard-Metzler task objects were shown separated by 30, 60 or 90 degrees in depth or about the objects' axes of symmetry.

Following pretesting, subjects were assigned to one of five groups: Three groups viewed films - one viewed the complete rotation film, one viewed the partial rotation film and one, the film with all rotations edited out. A fourth group received individualized training in rotating blocks to determine congruence and a fifth, which served as the control group, received no additional training. Each type of training was administered three times on separate occasions. Following training, the five groups were given two batteries of post tests, one immediately following the final training session and one two weeks later.

Before proceeding to the results of this study, I would like to say a few additional words about the training procedures. The three films were variants of the same basic film. One film showed a sequence of Shepard-Metzler-like problems as in the rotations test and also showed how the problems could be solved by demonstrating a representation of one object rotating into congruence with the other object. A second film only showed a partial rotation (5 - 10 degrees) and a third, which was otherwise identical to the other two had all rotations edited out. The active manipulation training consisted of providing the child with the exact

same set of problems as shown in the films and also showing him how to solve the problems by rotating an actual object, representing one of the objects in the problem, into a congruent orientation with the other object.

I shall deal with the results in terms of the questions I set out earlier: First, can performance be facilitated by viewing a filmed representation demonstrating the underlying mental process?

The results which are given in Table I indicate a significant improvement in performance following exposure to a film showing complete rotations. This improvement is evident for the film group compared to the control group. Furthermore as Figure 3 shows, this improvement for the film group is primarily due to facilitations on items requiring the larger size mental rotations of 90°. As can be seen, viewing this film resulted in a decline in the relationship between size of rotation and errors. This decline suggests that exposure to this film subsequently enabled children to produce larger mental rotations than they had produced prior to viewing the film or than a group which had not received any exposure to this film.

Next, how do film training and training in actively relating real objects compare? A comparison of these two groups with the no-treatment control indicated that, while both film and manipulation experimental groups differed from the control groups at both post-test sessions, there was no significant difference between the two experimental groups themselves. Furthermore, as the next slide shows, (See Figure 3) the error by rotation size relationship was highly similar for film and manipulation training of the different test sessions but not for the control group at the post tests. Again this relationship indicates facilitations primarily on the larger size rotations.

The third question concerns the effect of extent of rotation shown on film on the development of the ability to imagine these rotations. This question was addressed to the issue of whether it is better to show a child an act in full or a part of an act and induce him to complete the act on his own. If the child learns by imitating then showing him the film with complete rotations should be better than the one with partial rotations. However, if the child learns by being induced into thinking in a particular way then the partial rotations film should be superior to the complete film. While the results indicated no significant difference between the film groups, the two films showing some rotation did yield slightly better post-test performance than the film with the rotations edited out. An analysis of the relationship between rotation size and performance indicated the greater the extent of the rotation shown on film the further the child could rotate mentally after viewing the film.

The fourth question concerns the degree to which these forms of training transferred to other spatial tasks. Six transfer tasks were given: two standard spatial abilities tasks, an alternate-perspective-judgement test and a rotation task given at the first post-test and alternate versions of the two standard spatial ability tests given at the second delayed post-test session. The results indicated (See Table 1) that the 5 treatment groups differed only on the rotation task, which is a task requiring subjects to imagine the final appearance of a display following its being turned a specified number of degrees about a fixed axis. Facilitations on this task were mainly evident for the three treatment conditions, either mediated (complete and partial rotation films) or direct (manipulation training), which gave the subjects experience in making rotations and not for the conditions, namely no rotation film and no treatment control, which did not give them such experience. Interestingly, the greatest facilitation resulted from the partial

rotation film in which the subject had to imagine the final appearance of the object prior to determining congruence. Training probably did not transfer to other transfer tasks probably because these other tasks were most likely solved by strategies other than mental rotations.

The final question deals with the matter of individual differences in treatment effects; that is, for whom did the treatment work? This question was answered by examining the regression information of pretest scores plotted on post-test scores for the five different conditions. This method of analysis indicated that not only did the treatments differ in effectiveness as a function of ability level but that the more a treatment provided information about rotations the greater its benefit for less competent children. Table 2 indicates the flattest slopes and highest asymptotes for manipulation followed by the complete rotation film condition. These results suggest that the effects of training are most beneficial for the initially less competent subjects, the children who needed the information about rotations to alter their performance.

In sum the results have shown that audio-visual media can indeed facilitate the development of cognitive skills in children. This study convincingly demonstrates that children's ability to rotate images internally can be facilitated by viewing external representations of objects rotating in space. And, contrary to the beliefs of some individuals, such facilitations are in fact comparable to the facilitations from direct active experience.

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TABLE 1

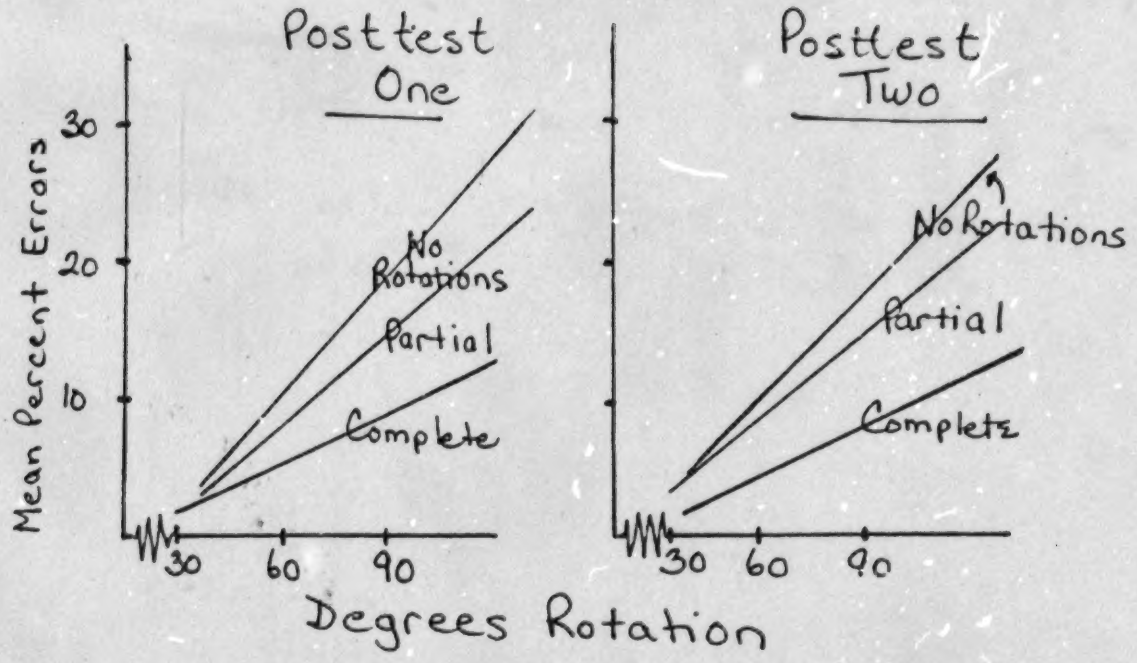
MEAN PERCENT CORRECT ON CRITERION AND TRANSFER ROTATION TESTS

TREATMENT CONDITION	CRITERION ROTATION TEST		TRANSFER TEST
	IMMEDIATE	DELAYED	
Activity	91.24	92.94	59.87
Complete Rotation Film	83.72	88.51	59.69
Partial Rotation Film	83.22	84.84	70.88
No Rotation Film	79.79	83.38	53.94
Control	71.33	81.81	50.18

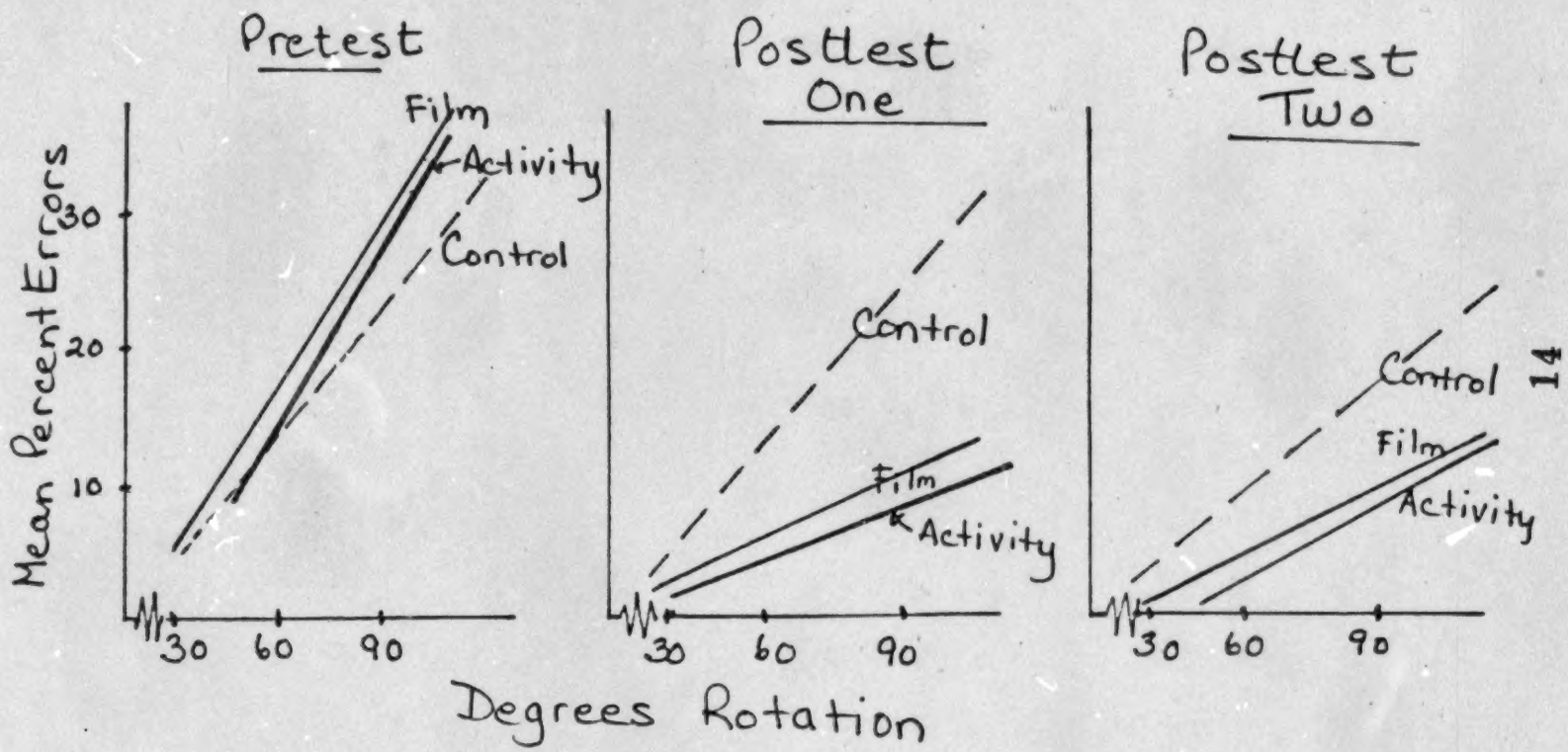
TABLE 2

REGRESSION INFORMATION FROM CORRELATIONS BETWEEN PRETEST (INITIAL ABILITY) AND POST-TEST ROTATION SCORES.

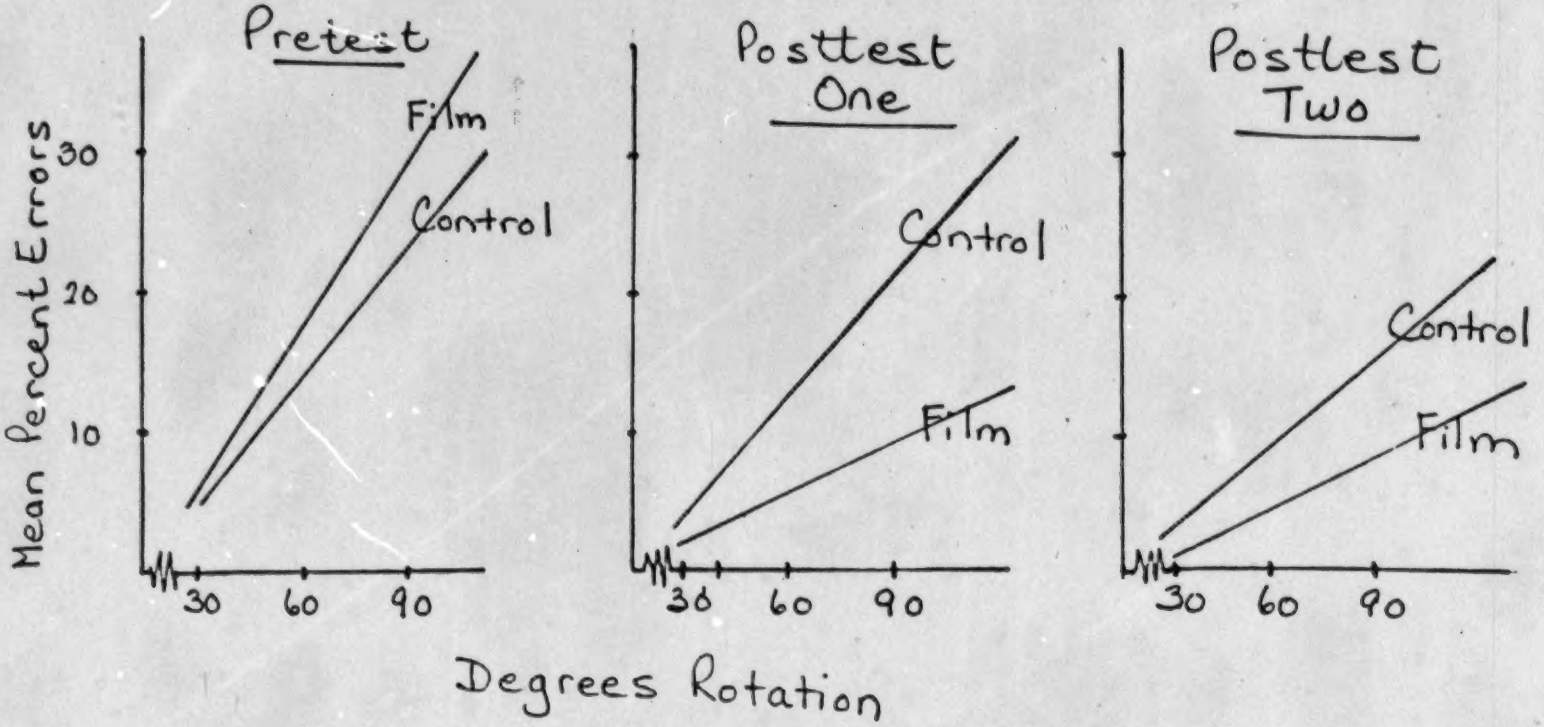
TREATMENT CONDITION	POST-TEST SESSION			
	IMMEDIATE		DELAYED	
	a	b	a	b
Manipulation	18.89	.40	26.77	.05
Complete Rotation Film	17.12	.39	18.60	.38
Partial Rotation Film	13.35	.53	17.80	.34
No Rotation Film	14.17	.47	15.82	.45
No-treatment Control	0.23	1.0	9.23	.72



Mean Percent Errors as a Function of Size of Rotation Required for 3 Film Conditions



Mean Percent Errors as a Function of Size of Rotation Required



Mean Percent Errors as A Function of Size of Rotation Required